

TITLE

Metals in Blood and Urine and Risk of Peripheral Arterial Disease

THEME

Advance Environmental Public Health Science and Research

KEYWORDS

lead, cadmium, tungsten, antimony, metals, peripheral arterial disease, cardiovascular disease, NHANES

BACKGROUND

Peripheral arterial disease is a consequence of atherosclerotic occlusion of blood flow in the muscular arteries of the lower extremities. Although there are biological reasons to suspect that exposure to metals may promote atherosclerosis, the cardiovascular effects of chronic low-dose exposure are largely unknown. This project was undertaken as part of the Johns Hopkins University Center for Excellence in EPHT to advance science and research in tracking, using available datasets.

OBJECTIVE(S)

To use a national tracking survey to evaluate the association between the prevalence of peripheral arterial disease and blood levels of lead and cadmium, and urinary levels of lead, cadmium, barium, cobalt, cesium, molybdenum, antimony, thallium and tungsten, in a representative sample of U.S. adults.

METHOD(S)

Cross-sectional study in participants ≥ 40 years of age in the 1999–2000 National Health and Nutrition Examination Survey (NHANES). Blood lead and cadmium were measured by atomic absorption spectrometry in 2,125 participants and urinary metals were measured by inductively coupled plasma-mass spectrometry in 790 participants. Peripheral arterial disease was defined as a blood pressure ankle brachial index <0.9 in at least one leg.

RESULT(S)

After multivariable adjustment, the odds ratios of peripheral arterial disease comparing quartiles 2 to 4 of blood lead with the lowest quartile were 1.63 (95% confidence interval 0.51–5.15), 1.92 (0.62–9.47), and 2.88 (0.87–9.47), respectively (P -trend = 0.002). The corresponding odds ratios for blood cadmium were 1.07 (0.44–2.60), 1.30 (0.69–2.44), and 2.82 (1.36–5.85), respectively (P -trend = 0.01). The odds ratio of peripheral arterial disease for current smokers compared with never smokers was 4.13. Adjustment for lead reduced this odds ratio to 3.38, and adjustment for cadmium reduced it to 1.84. In urine, the adjusted odds ratio for peripheral arterial disease comparing the 75th to the 25th percentile of the cadmium distribution was 3.05 (95% confidence interval 0.97–9.58). The corresponding figure for tungsten was 2.25 (0.97–5.24). Peripheral arterial disease risk increased sharply at low levels of antimony and remained elevated beyond 0.1 $\mu\text{g/L}$. Peripheral arterial disease was not associated with other metals in urine.

DISCUSSION/RECOMMENDATION(S)

Blood lead, blood cadmium and urinary cadmium were associated with an increased prevalence of peripheral arterial disease in the general U.S. population, at levels well below current safety standards. Although our findings need confirmation in prospective studies and support from mechanistic studies at low levels of exposure, they support a possible role for lead and cadmium in atherosclerosis. The results for tungsten and antimony need to be interpreted cautiously in the context of an explanatory analysis, but deserve further study. The widespread exposure to these metals in the general population and the limited relevant data on cardiovascular outcomes for most of them underscore the public health relevance of this study and the importance of tracking resources such as NHANES.

AUTHOR(S)

Eliseo Guallar, M.D., Dr.P.H.
Department of Epidemiology
Welch Center for Prevention, Epidemiology, and Clinical Research
Johns Hopkins University Bloomberg School of Public Health
2024 E. Monument St, Room 2-639
Baltimore, MD 21205
410-614-0574
eguallar@jhsph.edu

Ana Navas-Acien: anavasac@jhsph.edu
Richey Sharrett: rsharret@jhsph.edu
Elizabeth Selvin: lselvin@jhsph.edu
Ellen K. Silbergeld: esilberg@jhsph.edu

